

2014 TOMPKINS COUNTY GOVERNMENT OPERATIONS

GREENHOUSE GAS EMISSIONS AND ENERGY USE INVENTORY

TOMPKINS COUNTY PLANNING DEPARTMENT

SEPTEMBER 2016



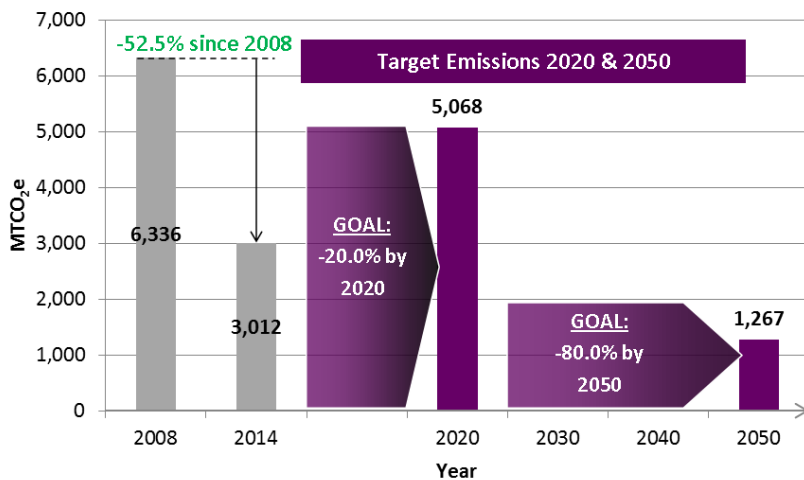
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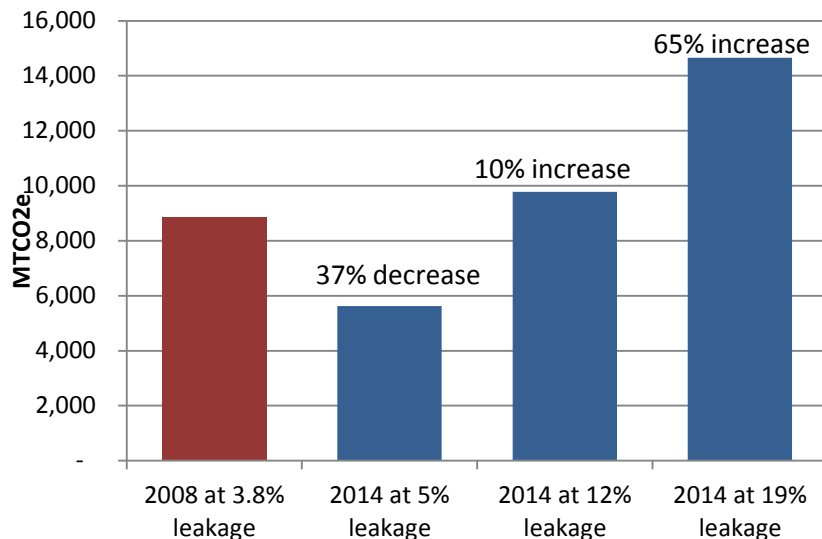
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County Government Inventory Executive Summary



GHG Emissions Goals and Progress – Currently Accepted Accounting



GHG Emissions – New Shale Gas Accounting

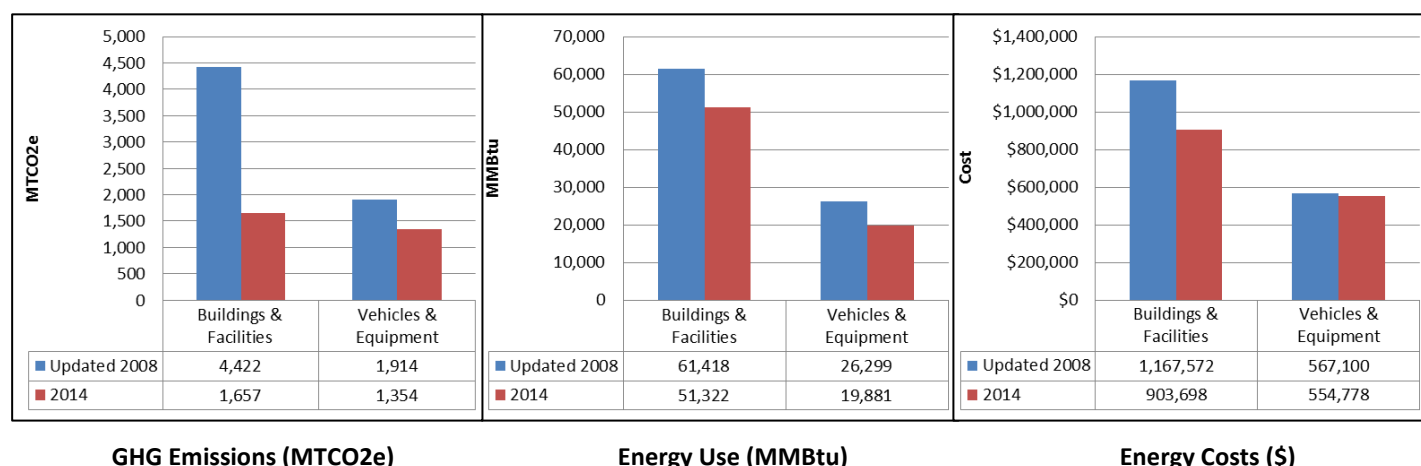
Tompkins County reduced the greenhouse gas (GHG) emissions from its government operations 53 percent from 2008 levels by 2014. This reduction far surpassed the target goal of a 20 percent reduction by 2020, and means that County government is nearly two-thirds of the way to achieving its goal of at least an 80 percent reduction from 2008 levels by 2050. Although this is encouraging news and reflects the positive results of the County's concerted efforts to reduce its emissions, this is tempered by the fact that a considerable amount of this reduction has been achieved through a major shift from coal to natural gas to power the electric grid, and there are growing concerns about the impact of natural gas extracted using high-volume hydrofracking techniques on total GHG emissions, including methane.

Between 2008 and 2014 the source of the gas used in the community, including by the Tompkins County government, transitioned from wells drilled through conventional methods to fracked gas, primarily coming from the Marcellus Shale in Pennsylvania. Emissions associated with fracked shale gas are calculated extremely differently depending on whether current accounting methods or evolving climate science accounting methods are applied. **If the new science is applied, the County government has not seen a remarkable 53 percent reduction in emissions, but instead has increased total GHG emissions by 10 percent between 2008-2014 if the 20-year global warming potential and mid-range overall leakage rate of 12% are applied for methane**

emissions. The higher leakage range of 19% would result in a 65% increase in emissions. While all recent local studies have pointed to the need to transition away from natural gas regardless of accounting methods, the conclusion that emissions are sharply increasing due to reliance on fracked gas calls for making that transition to renewable energy much more quickly. Applying this conclusion to the Inventory calls for rapidly adding more renewable electricity generation in the County and developing strategies to dramatically reduce reliance on natural gas.

While this tension between two GHG accounting methods runs throughout this document, the main focus is on presenting the results using generally accepted GHG accounting methodologies and calling out differences with new climate science accounting in separate sections of the report.

Results: Comparison of Emissions, Energy Use, and Energy Costs 2008-2014



The County government has two overarching sectors (1) Buildings & Facilities, which include electricity and thermal heating for all County buildings and facilities, including the Airport, Solid Waste Facilities, and County-owned Street Lights & Traffic Signals, and (2) Vehicles & Equipment, which includes both on- and off-road vehicles and equipment powered by vehicle fuels. Both sectors saw a decrease in GHG emissions, energy use, and energy costs between 2008 and 2014, although the decrease in costs for the Vehicle & Equipment Sector was relatively small at \$12,322.

The Buildings & Facilities Sector saw a significant reduction in emissions, largely due to the County's purchase of Green-e Energy Certified Renewable Energy Certificates, which allowed it to claim the environmental benefits of renewably-generated electricity for nearly all of its 2014 electricity use. The influence of these Renewable Energy Certificates means that emissions are less closely correlated with energy use for the Building & Facilities Sector.

Results: 2014 Emissions and Energy Use

GHG Emissions. The total County government GHG emissions 2014 were approximately 3,000 metric tons of carbon dioxide equivalent (MTCO₂e), with 52 percent of those emissions from natural gas consumption and 45 percent of emissions from County vehicles and equipment fueled by gasoline, biodiesel, diesel, and ethanol fuels.¹

Electricity. The total electricity consumed by County government operations in 2014 was 6,503,913 kWh. 6,100,000 kWh, or 94 percent, of that electricity was offset by the purchase of Green-e Energy Certified Renewable Energy Certificates, which allow the County to claim the environmental benefits of this renewably generated electricity rather than the party generating it.

Thermal Energy. The total amount of natural gas consumed for County government operations in 2014 was 295,868 therms. A small amount of propane and waste oil, 100 and 700 gallons respectively, was used for additional heating.

Vehicle and Equipment Fuel. In 2014, County government consumed 19,881 MMBtus of energy to fuel its vehicles and off-road equipment such as mowers and forklifts. Vehicles and equipment consumed 153,467 gallons of fuel.²

Next Steps. The results of this Inventory will be used to inform development of the update to the 2020 Energy Strategy, as well as future efforts to reduce GHG emissions and to reduce consumption of energy by Tompkins County government operations. In particular, this Inventory can better inform the nearer-term efforts by the County to: update its policies; pursue additional opportunities for renewable energy and improved energy efficiency; begin transitioning towards the use of electric vehicles in its fleet; and to continually monitor progress towards meeting the County's emissions reduction goals.

¹ MTCO₂e – a measure of the combined ability of emitted GHGs to trap heat.

² MMBtu – a measure of the energy content in fuel; used as a basis for comparing the energy content of various fuels.

2014 Tompkins County Government Operations GHG Emissions and Energy Use Inventory

Introduction

In 2008 the Tompkins County Legislature committed to reducing greenhouse gas emissions by at minimum two percent a year to achieve at least a 20 percent reduction from 2008 levels by 2020 and at least an 80 percent reduction by 2050. In the spring and summer of 2016, the Tompkins County Planning Department completed a 2014 greenhouse gas emissions inventory to measure County government progress towards meeting this commitment. Greenhouse gas emissions inventories provide an accounting of emissions during a particular time period, and when repeated over time they enable an organization to track changes in emissions and progress towards reduction goals, such as those set by the Tompkins County Legislature.

This report summarizes the greenhouse gas emissions produced by Tompkins County government operations for the 2014 calendar year, while also providing information regarding the County government's energy use and energy costs, and comparing 2014 to 2008 findings. This inventory is based upon the *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventory, Version 1.1*.³ ClearPath, an online application for the calculation and tracking of greenhouse gas emissions at the government operations and community scales, was used to calculate 2014 emissions. ClearPath is the most widely-used software tool for managing local climate mitigation efforts and is available to members of the International Council for Local Environmental Initiatives (ICLEI), including Tompkins County.

The Inventory uses Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report's 100 year Global Warming Potential (GWP) values and the 2008 inventory, which originally used the IPCC 2nd Assessment Report values, has been updated to the 5th Assessment 100 year values to allow direct comparison to the 2014 inventory. In addition, calculations using the latest climate science information on shale gas leakage and GWP were included as a separate analysis in this Inventory, to better inform actions to combat climate change. Additional details regarding the methodology used in this inventory and the updated 2008 inventory may be found in Appendix E.

Inclusion of RECs in 2014 Findings

A significant change between this 2014 inventory and previous inventories of Tompkins County government emissions is the inclusion of Renewable Energy Certificates (RECs). A REC is a tradable commodity that is created when harnessing energy from the wind, sun, water, plants, and other renewable sources. The owner of a REC is able to claim the environmental attributes, including reduced emissions, associated with the amount of renewably generated electricity the particular REC represents. Therefore, the entity producing the renewable energy cannot claim the environmental attributes of the energy generated if it does not retain ownership of the RECs for that energy.

In November 2012 Tompkins County, began purchasing Green-e Energy Certified Renewable Energy Certificates (Green-e RECs) to offset 100 percent of the County government's electricity usage.⁴ As a result of this purchase, the County is able to claim the environmental attributes of this renewably generated electricity even though the renewable energy is not generated by the County itself. The original producer of the energy cannot claim these

³ Developed in partnership and adopted by the California Air Resources Board, the California Climate Action Registry, ICLEI-Local Governments for Sustainability, and The Climate Registry.

⁴ Tompkins County Resolution 2012-241, adopted November 20, 2012 and authorizing purchase of electricity for the period ending December 31, 2014,

https://tompkinscountyny.igm2.com/Citizens/Detail_LegFile.aspx?ID=3681&highlightTerms=renewable%20energy%20credits.

attributes. Therefore, the zero emissions attributed to the Green-e RECs purchased by the County are used in this inventory's calculations.

These Green-e RECs represent 6,100,000 kWh of zero-emission electricity for calendar year 2014, and therefore eliminate most of the emissions that would otherwise be attributed to electricity use by the County government. In reality, the County's electricity use exceeded 6,100,000 kWh in 2014, so there are some remaining emissions associated with County government electricity consumption. Protocols for the treatment of RECs in emissions inventories is evolving, therefore Appendix C presents an alternative inventory of the 2014 Tompkins County government emissions *without* Green-e RECs included in emissions calculations.

Overview of Natural Gas Impacts

In conducting this analysis it has become clear that the biggest change in our energy system since 2008 has been the increased use of natural gas to generate electricity, largely replacing generation using coal and fuel oil, and the change in the source of that gas from wells drilled through conventional methods to fracked gas, primarily from the Marcellus Shale in Pennsylvania. Our methodology, using the protocols relied on by the International Council for Local Environmental Initiatives (ICLEI) in developing the ClearPath software tool, does not account for the impact of the change in the source of the natural gas or the increased focus internationally on the significance of methane as a greenhouse gas. Two factors are at play here: first, an international consensus is developing that methane should be accounted for at its 20 year warming impact (80 to 100 times that of carbon dioxide) rather than the 100 year impact (20 times CO₂) reflected in the methodology that has been applied to date; and second, evidence suggests that more methane escapes to the atmosphere in the fracking process than from conventional natural gas production and this can have a profound impact on the effect of gas production on the climate. These factors fundamentally alter our understanding of the impacts of use of natural gas in Tompkins County and in drawing electricity from a more natural gas intensive grid.

We are thus faced with the dilemma of trying to use consistent methodology to measure change across time while recognizing that the science is rapidly evolving and methods of calculating emissions will likely change to reflect increasing concern regarding the impacts of methane as a greenhouse gas. So while the ICLEI methodology shows a 52.5 percent reduction in emissions from 2008 to 2014, a remarkable accomplishment that would put us ahead of schedule to reach our goal of a 20 percent reduction by 2020, the real impact on climate change may be a different story. We have tried to accurately portray both stories in this report, one that shows progress toward our goal based on what we knew in 2008 and another that shows a significant increase in greenhouse gas emissions resulting from the transition to fracked gas. Going forward it is clear that we must rapidly build on our progress by adding more renewable electricity generation in the County and develop strategies to dramatically reduce reliance on natural gas.

Findings from the 2014 Inventory⁵

Overview

The total emissions from Tompkins County government operations in 2014 were 3,012 metric tons of carbon dioxide equivalent (MTCO_{2e}).⁶ Given that County government operations emitted 6,336 MTCO_{2e} in 2008. **This is a 52.5 percent reduction in Tompkins County government emissions between 2008 and 2014** (Figure 1).

⁵ Please note that all findings include the reduction in emissions from purchased Green-e RECs as discussed above.

⁶ MTCO_{2e} is a measure that aggregates different greenhouse gases into a single measure, using global warming potentials.

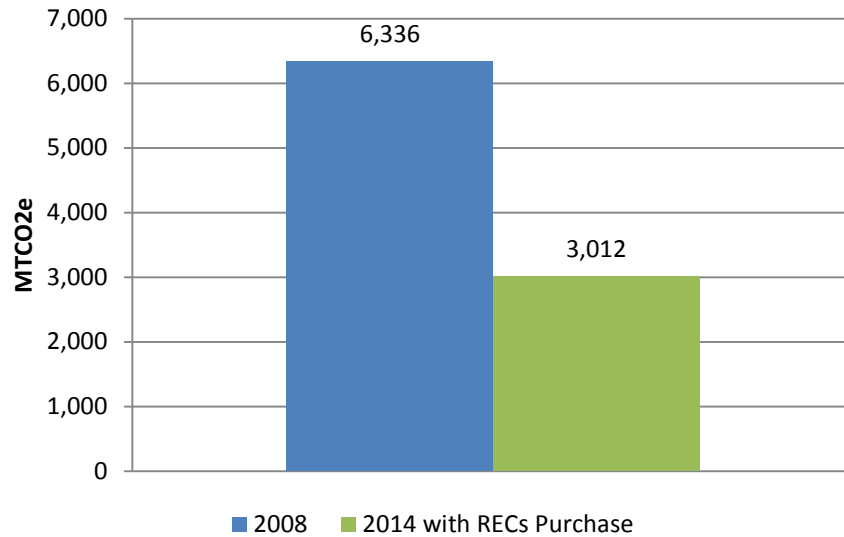


Figure 1. Total MTCO₂e emissions in 2008 and 2014

By this measure, County government emissions reductions have already exceeded the goal of 20 percent emissions reductions by 2020. If the County government can continue a similar pace of reductions moving forward, these reductions should meet or exceed the goal of 80 percent emissions reductions by 2050. Although the County's reduction goals are community-wide and its government operations are a small portion of the entire community's emissions, the County has most direct control over its own government emissions and its efforts to reduce them provide the opportunity to lead by example.

Emissions by Fuel Type and Sector

In 2014, natural gas used for heat and hot water produced 52.3 percent of the County government's emissions – the most of any single fuel source (Figure 2). Vehicle fuels including gasoline, biodiesel, diesel, and ethanol fuels for the County fleet together represent 45.0 percent of total emissions. Waste oil and propane used to heat the Highway Satellite Facility together contribute 0.3 percent of emissions. Due to the purchase of Green-e RECs, electricity accounted for just 2.5 percent of emissions.

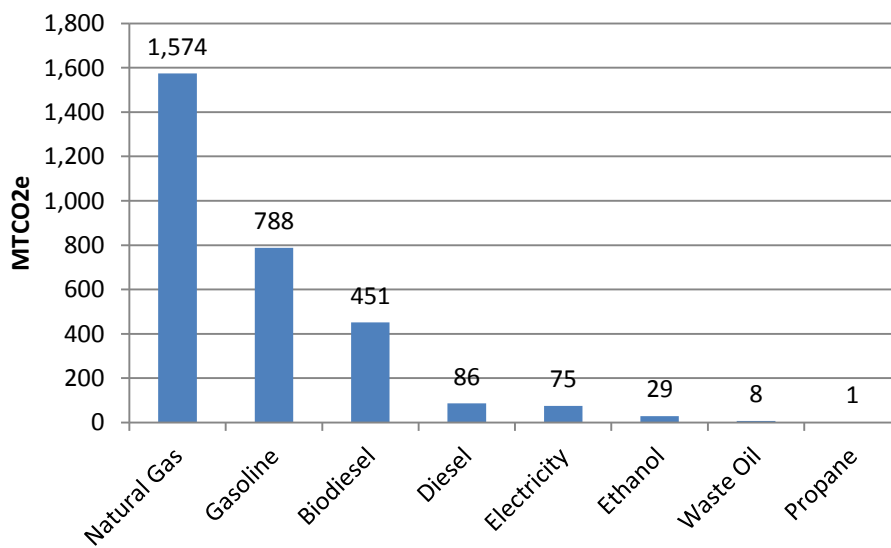


Figure 2. Breakdown of total MTCO₂e emission by fuel type, including Green-e RECs

The *Local Government Operations Protocol* uses the following local government sectors to categorize emissions:⁷

- Buildings and other facilities
- Streetlights and traffic signals
- Airport facilities
- Vehicle fleet⁸
- Solid waste facilities

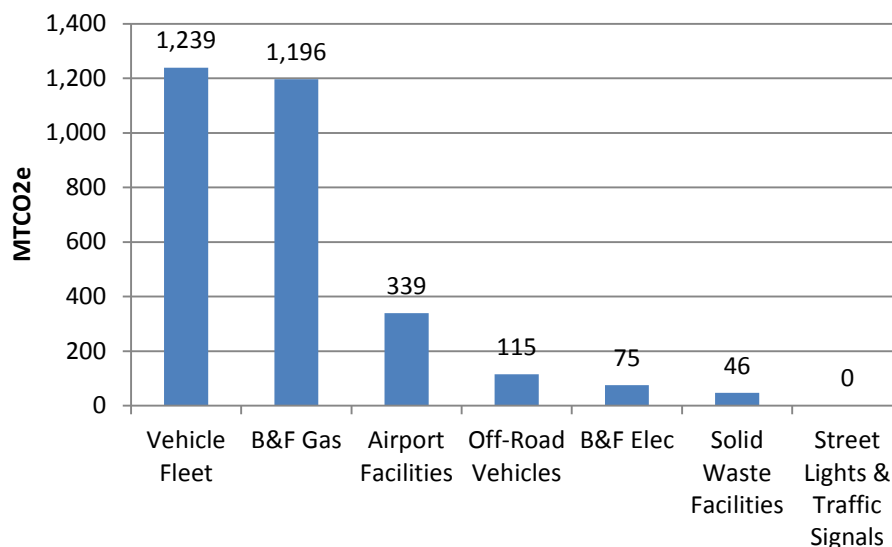


Figure 3. Breakdown of total MTCO₂e emission by sector, including Green-e- RECs⁹

Vehicle Fleet

The County vehicle fleet included 225 vehicles in 2014 and was the second largest source of emissions, as it has been in previous inventories. The fleet used 18,092 MMBtu of energy, and generated 1,239 MTCO₂e, representing 41.1 percent of County government emissions.

Buildings and Facilities¹⁰

Buildings and facilities operated by the County used 38,255 MMBtu of energy, including natural gas and electricity, and generated 1,271 MTCO₂e in 2014.¹¹ Although the Green-e RECs significantly reduced the electricity portion of this sector's emissions, at 38 percent of its total emissions, buildings and facilities continue to be the largest emitters as they have been in the three previous County government emissions inventories.

⁷ Note that additional sectors include transit fleet as well as water delivery, port, power generation, and wastewater facilities. However these sectors are not part of Tompkins County government operations.

⁸ Note that Vehicle Fleet includes on and off-road vehicles, which are calculated differently and shown separately in the following charts since the off-road vehicles include equipment such as mowers and forklifts which are not necessarily used for transportation purposes.

⁹ Note that B&F (Buildings & Facilities) Gas includes emissions from waste oil and propane use at the Highway Satellite Facility.

¹⁰ Note that per the Protocol, Airport and Solid Waste buildings and facilities are not included in this sector.

¹¹ MMBtu stands for one million British Thermal Units, a measure of the energy content in fuel. One Btu is the amount of work needed to raise the temperature of one pound of water by one degree Fahrenheit. MMBtu is used as a basis for comparing the energy content of various grades of natural gas and other fuels.

Airport Facilities

The County's airport facilities include the Airport Terminal and its outdoor lights, T Hangar I, T Hangar II, the Old IHA Hangar, the Crash Fire and Rescue Building, and the Sand Storage Building. These facilities used 11,112 MMBtu of energy and generated 339 MTCO₂e in 2014, representing 11.3 percent of County government emissions.

Off-Road Vehicles

The County's off-road vehicles include equipment such as forklifts, loaders, and mowers. Both the Airport and the Highway Division use these types of vehicles and equipment, which in total used 1,789 MMBtu of energy and generated 115 MTCO₂e in 2014, representing 3.8 percent of County government emissions.

Solid Waste Facilities

The County's solid waste facilities include the Solid Waste Office, the Recycling Center, and the Solid Waste - Household Hazardous Waste Building. These facilities used 1,822 MMBtu of energy and generated 46 MTCO₂e in 2014, representing 1.5 percent of County government emissions.

Street Lights and Traffic Signals

The County's Highway Division operates six traffic signals and one set of street lights. These lights and signals used 132 MMBtu of energy and generated 0 MTCO₂e in 2014, representing 0.0 percent of County government emissions.

Energy Use

In 2014 Tompkins County government operations used a total of 71,203 MMBtu. This use represents the actual energy required by County facilities, vehicles, and equipment for their operation in 2014.

Electricity

County government operations used 6,503,913 kWh of electricity in 2014. The Airport Facilities, Tompkins County Public Library, and Human Services Building were the three biggest consumers (Figure 4). They used 1,386,040 kWh, 869,808 kWh, and 735,738 kWh of electricity respectively in 2014.

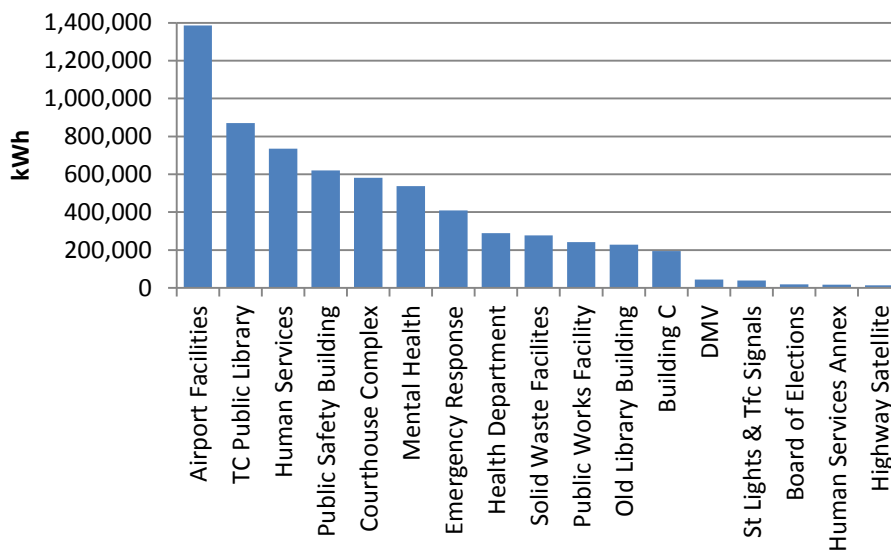


Figure 4. Electricity use by County facilities

The facilities' electricity use includes electricity delivered by the grid as well as any solar electricity generated and used on site by photovoltaic (PV) panels installed on County facilities. Figure 5 indicates the facilities whose PV panel(s) started operating by the end of 2014 and their annual solar electricity generation over 2014.

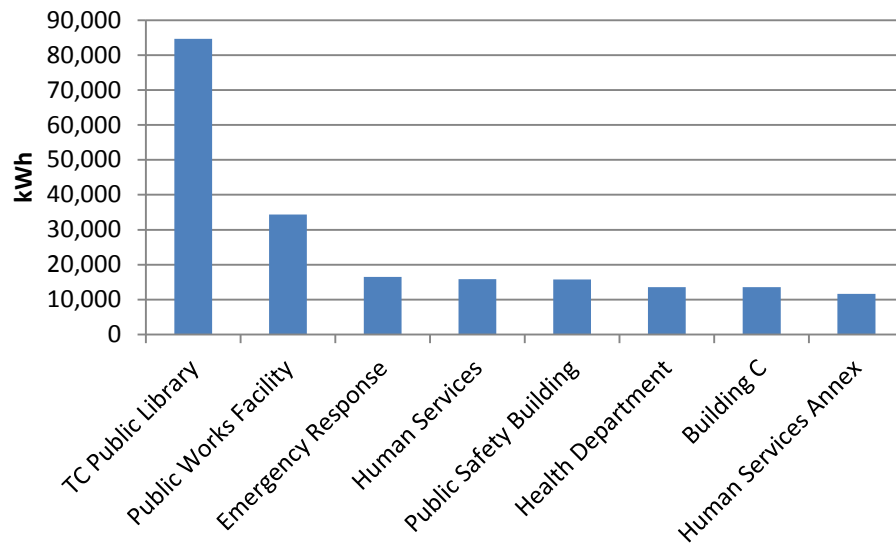


Figure 5. Solar electricity generated at County facilities in 2014

Natural Gas

The total natural gas used for County government operations in 2014 was 295,868 therms. The Airport Facilities, Courthouse Complex, and Public Works Facility were the three biggest consumers (Figure 6). They used 63,812 therms, 32,744 therms, and 31,722 therms of natural gas respectively in 2014.

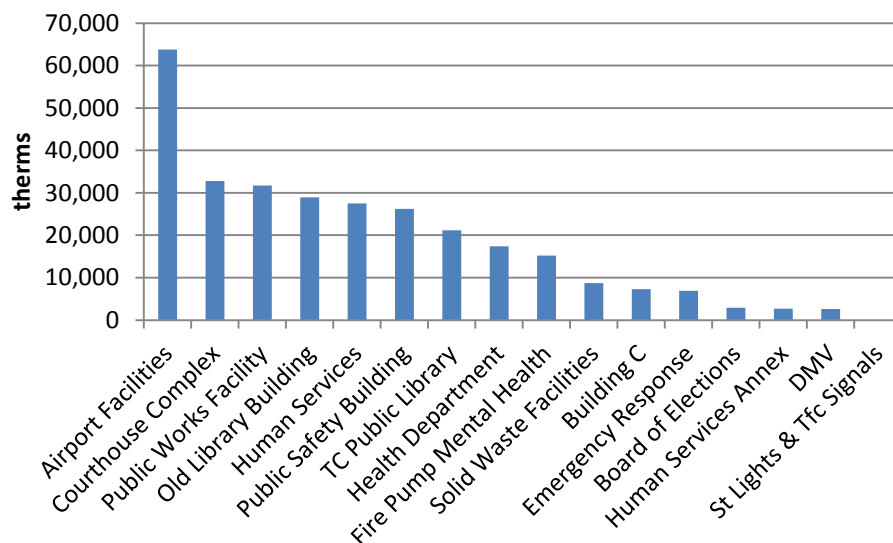


Figure 6. Natural gas uses of the facilities

Propane and Fuel Oil

The Highway Satellite Facility used 100 gallons of propane and 700 gallons of waste oil to run a heater in 2014. This waste oil most closely resembles No. 6 fuel oil, and is treated as such in calculating emissions.

Vehicle Fuel¹²

The total vehicle fuel used for County government operations in 2014 was 153,467 gallons. Figure 7 presents the annual vehicle fuel use by each department in a descending order. The Highway Division, Sheriff's Office, Social Services (noted as DSS in the figures), Airport, and Facilities Division were the five biggest consumers. They used 75,003 gallons, 51,962 gallons, 6,373 gallons, 4,811 gallons, and 4,633 gallons of fuel respectively in 2014.

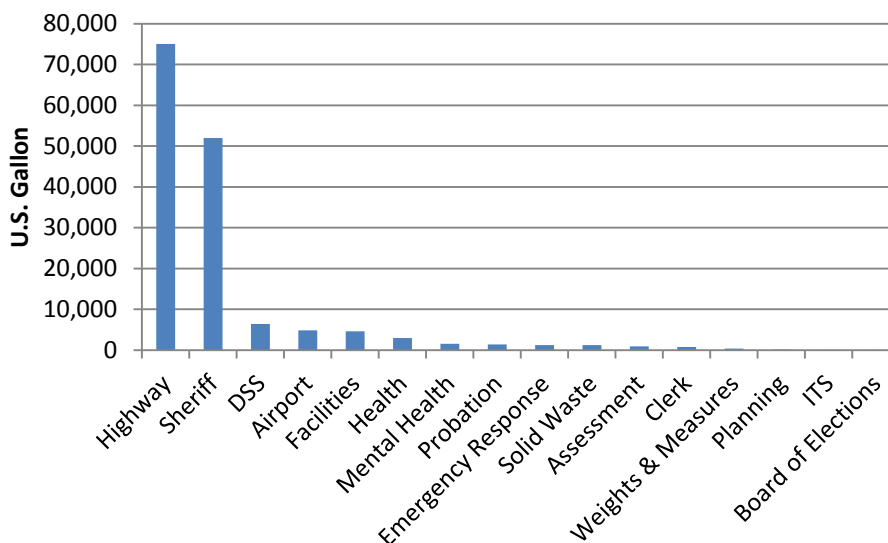


Figure 7. Annual vehicle fuel uses of the departments

The County departments with the highest annual vehicle fuel use are Highway, Sheriff's Office, Social Services, Airport, and Facilities (Figure 7). Gasoline was the major fuel for the Sheriff's Office, Department of Social Services, and Facilities Division. For the Highway Division, the major fuel was biodiesel (Figure 8). The Sheriff's Office and Highway Division consumed 98 gallons and 74 gallons of kerosene respectively in 2014, which is too small a quantity to appear in Figure 8. Kerosene was mixed in with diesel when it was purchased by the Sheriff's Office, and some suppliers classified this diesel as kerosene. At the Highway Division, kerosene was used for a pressure washer to wash trucks. The pressure washer burns kerosene to produce heat for hot water. As the consumption was minimal and they were not used directly by vehicles, kerosene is not shown in the breakdown of fuel below.

¹² Note that vehicle fuel includes fuel used by off-road vehicles and equipment as well as on-road vehicles.

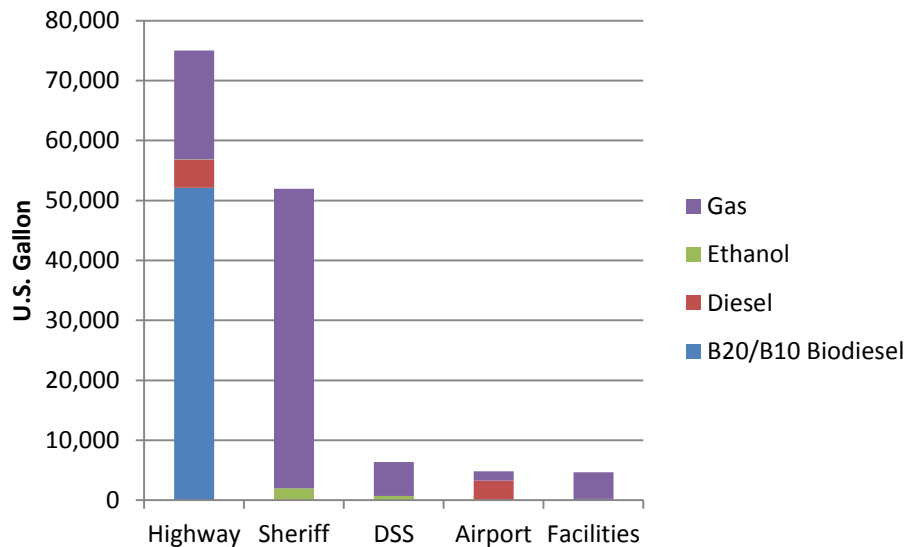


Figure 8. Breakdown of annual vehicle fuel use by fuel type among the largest users

Both the Highway Division and Airport have equipment not intended for regular on-road uses that are classified as off-road vehicles, such as front loaders and lawn mowers. The total fuel consumed for running off-road vehicles was 13,110 gallons. All 2,349 gallons used for Airport off-road vehicles was diesel. Of the 10,761 gallons consumed by Highway off-road vehicles, 98 percent was B20/B10 biodiesel, while the remainder was gasoline. Jet fuel consumed by planes using the Airport facilities is not used for government operations, and therefore is included in the Community GHG Emissions Inventory.

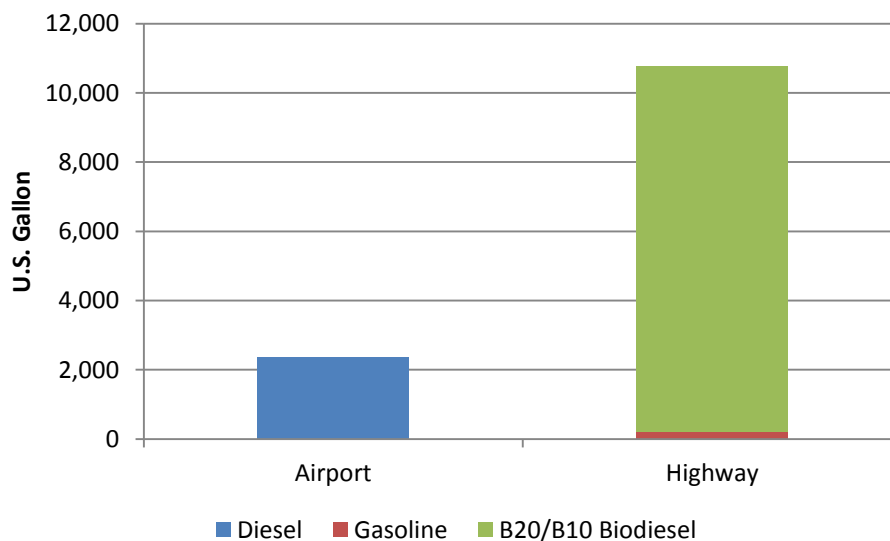


Figure 9. Annual fuel use of off-road vehicles

Energy Costs

The energy required for Tompkins County government operations in 2014 cost \$1,458,477, with the purchase of Green-e RECs included. Tompkins County spent \$276,195, or 15.9% less than it did on energy costs in 2008 (Figure 10).

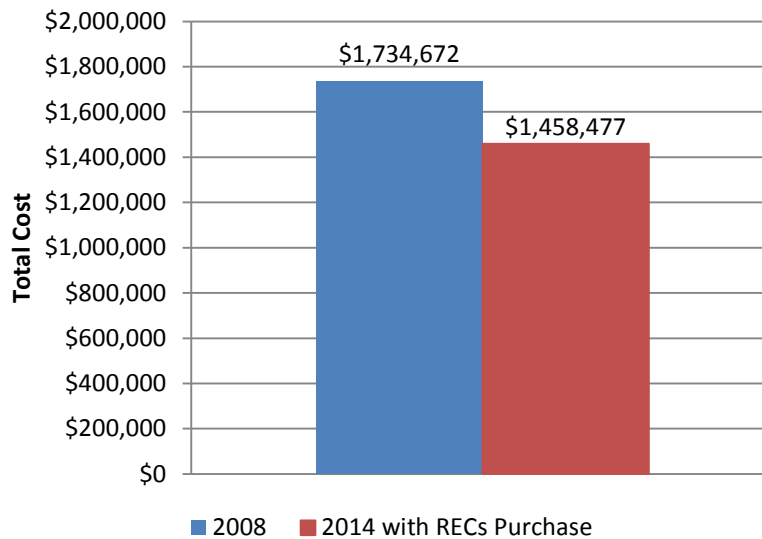


Figure 10. Total costs for energy consumed in 2008 and 2014

Energy costs were greatest for the vehicle fleet at \$503,853, or 34.5 percent of total energy costs. These costs were followed closely by electricity for buildings and facilities, which at \$479,926 accounts for 32.9 percent of total energy costs (Figure 11).¹³

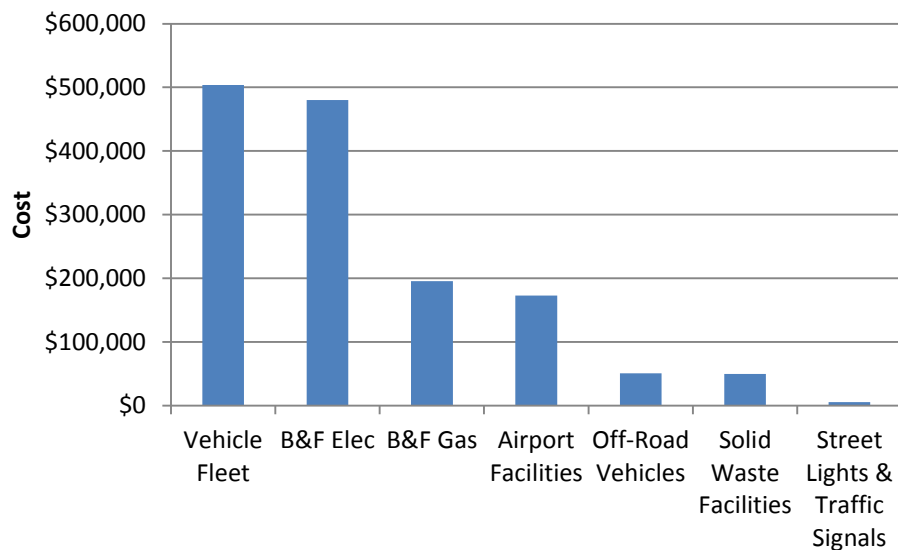


Figure 11. Breakdown of total cost by sector

In terms of costs by fuel type, at \$645,875 or 44.3 percent of total energy costs, electricity is the largest expense (Figure 12). Fuels used for the vehicle fleet and off-road vehicles, including gasoline, biodiesel, diesel, and ethanol, together cost \$554,778, or 38 percent of the total County government energy costs.

¹³ Note that the Airport and Solid Waste Facilities costs include both electricity and natural gas used at those facilities.

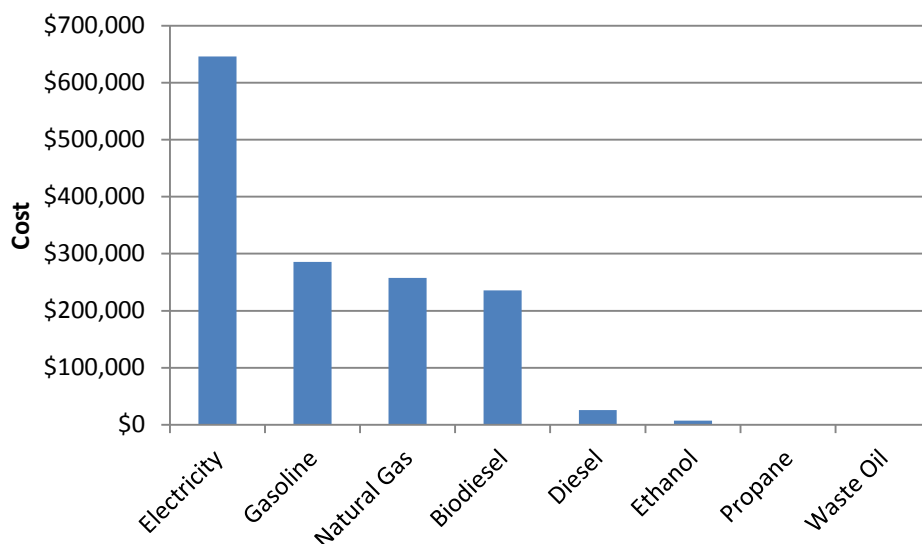


Figure 12. Breakdown of total cost by fuel type

Applying Latest Climate Science on Shale Gas to Results

In addition to the GHG Emissions Inventory based on internationally recognized protocols and software tools, the GHG Emissions Inventory for 2014 for the first time includes a separate section and accounting that looks ahead at what may soon be modifications to those protocols to better understand the impacts to the climate of burning shale gas in the County. Between 2008 and 2014, there was a profound shift in how the natural gas consumed in the community, including by County government was extracted from the ground, as well as new international recommendations on the time horizon and global warming potential (GWP) that should be used to calculate the GHG emissions for methane.

Studies conducted by local internationally-renowned experts, including Dr. Bob Howarth and Dr. Tony Ingraffea, have informed this section of the Inventory, with Dr. Howarth providing appropriate figures to include in these calculations. It is estimated that 5-19 percent of unburned methane leaks from production well to combustion in the home or business due in large part to the techniques employed by the shale gas industry. The analysis applies leakage rates of 5, 12, and 19 percent to all natural gas consumed by County government, including the portion used to generate electricity (Table 1). Leakage not only increases emissions from direct use of natural gas, but also increases emissions from electricity use due to the increasing use of natural gas to generate electricity (Figure 13).

In addition to the leakage of methane due to shale gas development and distribution, is the consideration of the appropriate timescale for GWP of methane. Methane is an extremely impactful GHG in the short-term, with a greenhouse warming effect of >100-fold more than carbon dioxide in the short-term. Given the current state of the Earth's climate, the Earth is predicted to warm by 1.5° C above the preindustrial baseline within the next 15 years and by 2° C within the next 35 years giving new urgency to the role of methane in the short-term. Standard GHG accounting principles call for the use of the 100-year GWP for greenhouse gases, which is appropriate for the other GHGs, however this analysis applies the 20-year GWP for methane of 86 to all methane emissions in 2014.

	2014 with 100-yr GWP and without Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 5% Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 12% Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 19% Leakage
MTCO ₂ e from Leaked Methane	n/a	2,612	6,768	11,642
Total Government MTCO ₂ e with Leakage	3,012	5,624	9,780	14,654

Table 1. 2014 Emissions as 5%, 12% and 19% Methane Leakage and GWP of 86

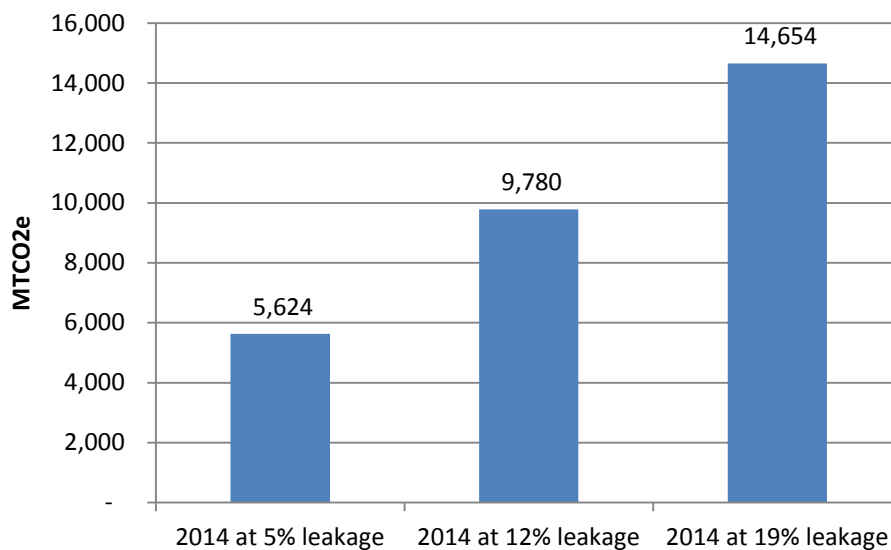


Figure 13: 2014 Emissions at 5%. 12% and 19% Methane Leakage and GWP of 86

Weather Conditions in 2014

In 2014, there were 7,403 Heating Degree Days (HDD) where the average temperature was below 65° Fahrenheit, the temperature below which buildings are considered to need to be heated (Table 2). There were 342 Cooling Degree Days (CDD) where the average temperature is above 65° Fahrenheit and people start to use air conditioning to cool their buildings. During the past 45 years (1970-2015), there were an average of 7,091 Heating Degree Days and 432 Cooling Degree Days. This indicates that 2014 was cooler in the summer and colder in the winter than past years. Therefore, one would expect that less electricity would be needed in 2014 compared to the past 45 years for air conditioning, and more natural gas and other thermal fuels for space heating.

	HDD Higher number = colder winter	CDD Higher number = hotter summer
2008	6975	387
2009	7031	272
2010	6641	622
2011	6615	526
2012	6202	543
2013	7106	479
2014	7403	342
2015	6954	445
Average 1970-2015	7,091	432

Table 2. Heating and Cooling Degree Days, 2008-2015

2008 and 2014 Inventories: Comparison and Findings

Between 2008 and 2014, County government emissions decreased by 52.5 percent. Although alterations to particular buildings and facilities are detailed in Appendix D, the following changes since 2008 have been critical in reducing emissions:

Transforming the Electric Grid

According to the U.S. EPA's Emissions & Generation Resource Integrated Database for 2012 (eGRID 2012), the CO₂ emissions factor of electricity generation in the New York Upstate Subregion declined from 720.8 lbs/MWh to 408.8 lbs/MWh since 2008 due to the shift of fuel use from coal to natural gas and renewable energy. A changing grid reduces emissions for users of the electricity, including County government. This reduction, however, would be largely offset if applying the methane emissions factors outlined in the "Applying the Latest Climate Science" section of this report to electricity produced with natural gas.

Renewable Energy Credits (RECs)

RECs Purchased (Green-e RECs)

As previously mentioned, in November 2012 Tompkins County began purchasing Green-e Energy Certified Renewable Energy Credits (Green-e RECs) to offset 100 percent of the County's electricity usage. These Green-e RECs reduced the County's 2014 electricity-related emissions, however, they do not represent actual reductions in energy use by County government.

RECs Generated but not Retained

In 2011, Tompkins County entered into a 15-year lease agreement with Solar Liberty to install solar panels on the following seven County government buildings: Building C; Emergency Response Center; Health Department; Human Services Annex; Human Services Building; Public Safety Building; and the Public Works Building. All panels were producing electricity in 2014, however the panels on the Public Safety Building were not operational until September 3, 2014. Under the terms of the agreement, Solar Liberty retains ownership of the RECs generated by these panels and can sell them to other parties wishing to reduce their emissions. Therefore, although the solar panels on County government buildings generate these RECs, Tompkins County does not own the panels or retain ownership of these RECs and they do not reduce the County government's emissions.

RECs Generated and Retained

One County building, the Tompkins County Public Library, has solar panels installed which are owned by Tompkins County. Installed by SunPower in 2000, the County retains the RECs from the electricity they generate. As a result, these RECs do reduce the County government's emissions.

Energy Performance Contract

Tompkins County and Johnson Controls, Inc. entered into an Energy Performance Contract (EPC) in December 2005. The contract guarantees that Tompkins County will realize \$4,154,367 of energy cost avoidance between February 2007 and January 2022. Although most improvements to County buildings occurred before 2008, an additional EPC was executed in January 2013 for the purpose of upgrading energy equipment and systems within the Public Safety Building. Although these additional improvements were not fully completed until September 2015, a number of improvements were completed prior to or during the early months of 2014 and therefore provided reductions in energy use and associated emissions.

Green Fleet Policy

In 2009 the Tompkins County Legislature adopted a green fleet policy for the County which requires each department to reduce its fleet emissions by 2 percent annually in order to help the County reach its emissions reduction goals. By 2014, nine hybrid vehicles and one electric vehicle had been added to the County fleet, and car sharing between the Planning and Assessment Departments had increased.¹⁴

As departments replaced vehicles between 2008 and 2014, newer vehicles typically provided greater fuel efficiency, further reducing the County government's emissions. U.S. gas prices experienced a high spike in the second half of 2008, and in 2009 major changes began in the Corporate Average Fuel Economy (CAFE) standards for new vehicles sold in the U.S. to encourage greater fuel efficiency. These changes have resulted in manufacturers producing vehicles with lower CO₂ emissions and record fuel economy.¹⁵

While the 2008 inventory found that increasing fuel consumption by the County's fleet was contributing to increased County emissions between 1998 and 2008, the 2014 inventory finds a successful reversal of this trend. In addition to the green fleet policy, improved fuel economy of newer vehicles, and car sharing to slightly lessen the need for additional vehicles, technology may also be playing a role. Webinars and web-based meetings have become more common, and County facilities and technology have been improved to encourage participation in online meetings. Although vehicle miles traveled (VMT) was not tracked in 2008, there is anecdotal evidence that travel for in-person meetings both within the County and to more distant destinations, such as Albany, has been declining and resulting in less fuel consumption and associated vehicle emissions.

Changing Vehicle Fuels

In 2014, 3,566 gallons of fuel purchased for vehicles using gasoline were blended with ethanol (5.7% or 10%), resulting in lower emissions than unblended gasoline. Although ethanol blended gasoline was not tracked separately in 2008 and all gasoline was considered to be unblended, increasing oil prices and changing energy regulations in 2008 helped to increase the proportion of ethanol blended gasoline used in vehicles by 2014, including the County's fleet.

In 2009 the Tompkins County Highway Department began transitioning its diesel vehicles, which account for more than three-quarters of its fleet, to B10 and B20 biodiesel. Biodiesel emits less CO₂e than conventional diesel, and this change accounts for 59.4 percent of the reduced vehicle fleet emissions between 2008 and 2014.

Although it does not reduce emissions in the context of the software used in this inventory, County vehicles used 4,641 gallons of ultra-low-sulfur diesel (ULSD) in 2014, whereas in 2008 all diesel vehicles were using traditional diesel fuel. Diesel fuel use is the primary source of black carbon emissions in the U.S., and the combination of ULSD and newer diesel vehicles designed for ULSD use has greatly reduced this component of particulate matter (soot).¹⁶ The U.S. Environmental Protection Agency expects reduced black carbon emissions to provide climate benefits within the next several decades due to its short atmospheric lifetime and strong warming potential.

¹⁴ Although the electric vehicle was in use in 2014, it has since been removed from the County fleet, so the County currently does not have any electric vehicles.

¹⁵ Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends:1975-2015, <https://www3.epa.gov/otaq/fetrends.htm>

¹⁶ https://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm, <https://www3.epa.gov/blackcarbon/mitigation.html>

Breakdown of Total Emissions by Sector and Fuel Type

As previously discussed, the purchase of Green-e RECs substantially reduced emissions from the Buildings & Facilities electricity consumption. After this reduction, Solid Waste Facilities experienced the second largest emissions reduction from 2008 to 2014 among all the sectors at 86.0 percent (Figure 14).¹⁷ Possible reasons for the significant reduction of CO₂e emission are:

- 1) The recycling process changed from a dual stream sorting process to a single stream transfer in 2011. Prior to 2011, a lot of sorting equipment was operated at the Recycling Center and Solid Waste Transfer Station. In 2011, the majority of that equipment was taken out and most of the recyclables have been transferred to a facility in Ontario County for processing ever since.
- 2) Changing grid. According to EPA eGRID 2012, the CO₂ emission factor of electricity generation went down from 720.8 lbs/MWh to 408.8 lbs/MWh since 2008 due to the shift of fuel use from coal to natural gas and renewable energy. A changing grid may explain ~43.4 percent of the emission reduction from electricity use.

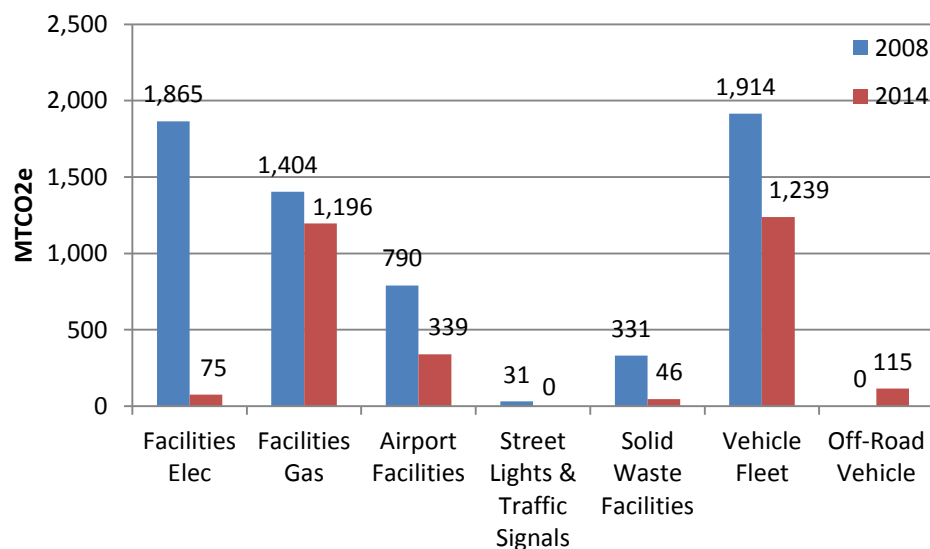


Figure 13. Comparison of emissions by sector

The changing grid may also explain the emissions reduction from Street Lights & Traffic Signals, Airport Facilities, and electricity use at the other County-operated facilities (noted as B&F Elec in the figure). Besides, solar generation and net-metering offset some electricity provided by the grid. The sale of the Biggs Building in 2010 and the K-House in 2013 also contributed to the County government's reduced electricity and natural gas use.

Figure 15 provides the breakdown of the total CO₂e emissions in 2008 and 2014 by fuel type. There was a significant 90.0% drop of emissions from the use of diesel. Tompkins County began switching some of its vehicle and equipment from diesel to biodiesel in 2009. In 2014, 23,547 gallons of B10¹⁸ biodiesel and 28,522 gallons of B20 biodiesel were purchased, representing a reduction of approximately 67 MT of CO₂e emissions over the equivalent

¹⁷ Solid waste facilities include the Solid Waste Office, the Recycling Center and Solid Waste Transfer Station, and the Solid Waste – Household Hazardous Waste Building.

¹⁸ Biodiesel is a diesel fuel produced from plant oils or animal fats. It is commonly sold blended with diesel derived from petroleum. Common blends include "B2" (2% biodiesel), "B5" (5% biodiesel), "B10" (10% biodiesel), and "B100" (100% biodiesel) (<http://www.bioenergywiki.net/Biodiesel>).

amount of ultra-low sulfur diesel fuel. Other types of alternative fuels such as ethanol and kerosene were also used in 2014.

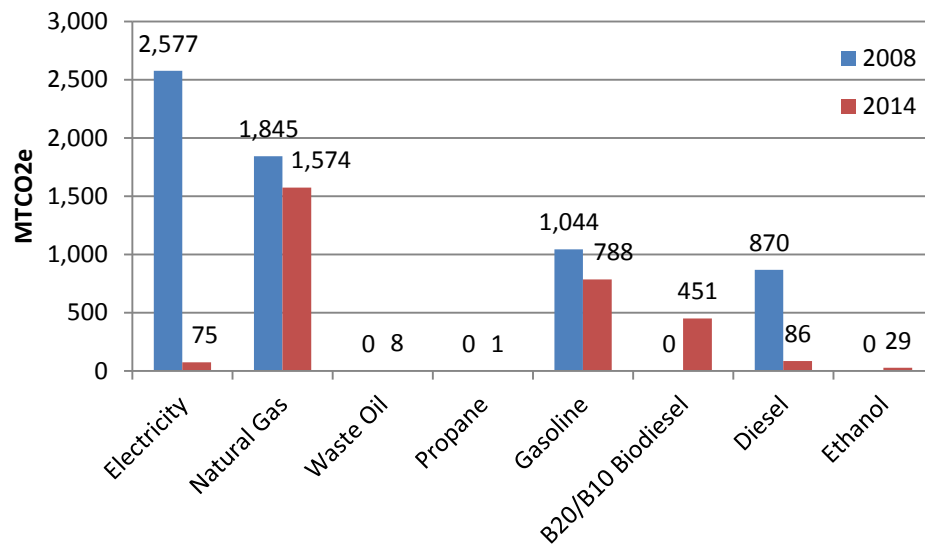


Figure 15. Comparison of emissions by fuel type

Breakdown of Energy Use by Facility

Although the purchase of Green-e RECs reduces emissions from facilities' electricity use, it does not necessarily equate to a reduction in actual energy use. Figure 16 provides the breakdown of energy use (MMBtu) by County facility, including electricity consumption as well as any natural gas consumption.

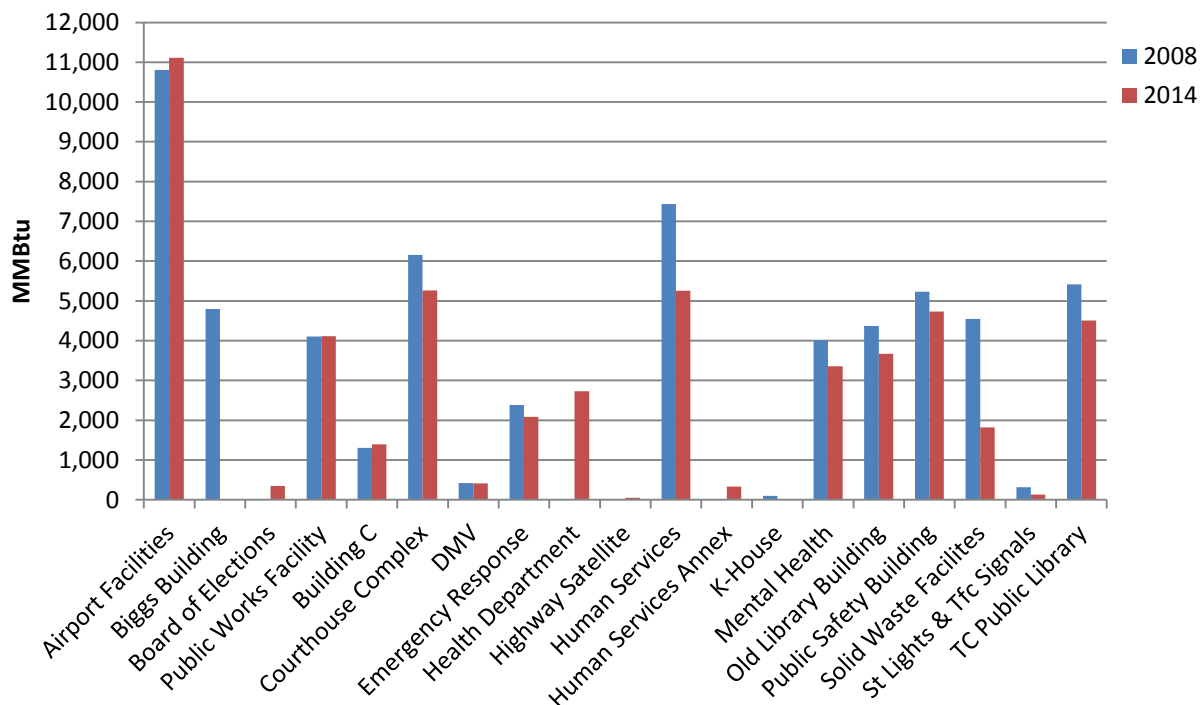


Figure 16. Comparison of energy use by facility

Breakdown of Emissions from Vehicle Fuel Use by Department

Figure 17 provides the breakdown of the total CO2e emissions in 2008 and 2014 from vehicle fuel use by department. Additional information about changes within specific departments that affected vehicle fuel use changes between 2008 and 2014 may be found in Appendix D.

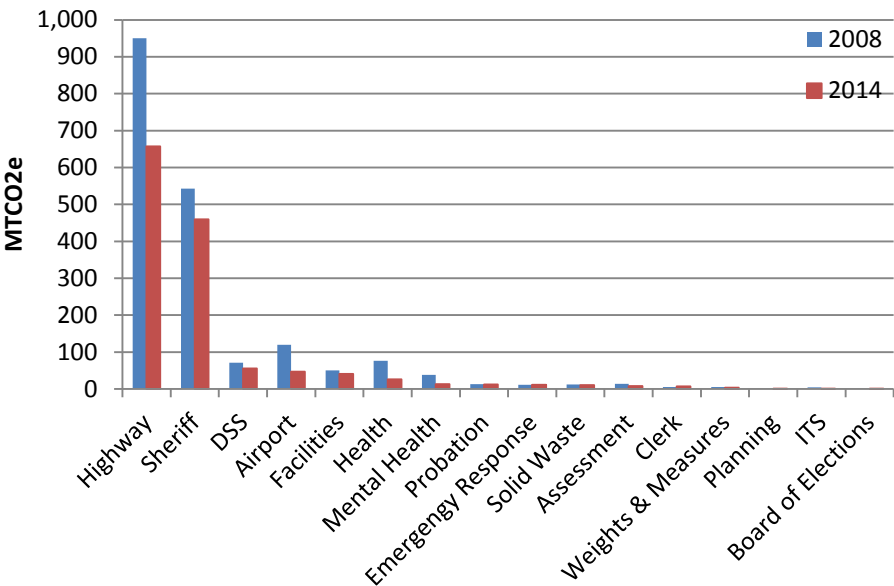


Figure 17. Comparison of emissions from vehicle fuel use by department

Applying Latest Climate Science on Shale Gas to Results: 2008-2014

Between 2008 and 2014, there was a profound shift in how the natural gas consumed in the County was extracted from the ground, as well as new international recommendations on the time horizon and global warming potential (GWP) that should be used to calculate the GHG emissions for methane. While the results presented above are calculated using widely-accepted international protocols, it is important to look ahead at what may soon be modifications to those protocols to better understand the impacts to the climate of burning shale gas in the County and better inform near-term actions.

Studies conducted by local internationally-renowned experts, including Dr. Bob Howarth and Dr. Tony Ingraffea, have informed this section of the Inventory, with Dr. Howarth providing appropriate figures to include in these calculations. It is estimated that 5-19 percent of unburned methane leaks from production well to combustion in the home or business due to the techniques employed by the shale gas industry. The analysis below applies an average leakage factor of 12 percent to all natural gas consumed by County government operations. In 2008, the natural gas consumed in the County came from traditionally drilled vertical wells. Dr. Howarth advises that traditional extraction methods experience a 3.8 percent leakage rate. Therefore, a leakage factor of 3.8 percent was applied to methane consumed in 2008, as well.

In addition to the leakage of methane due to shale gas development and distribution, is the consideration of the appropriate timescale for GWP of methane. Methane is an extremely impactful GHG in the short-term, with a greenhouse warming effect of >100-fold more than carbon dioxide in the short-term. Given the current state of the Earth’s climate, the Earth is predicted to warm by 1.5° C above the preindustrial baseline within the next 15 years and by 2° C within the next 35 years, giving new urgency to the role of methane in the short-term. Standard GHG accounting principles call for the use of the 100-year GWP for greenhouse gases, which is appropriate for the other

GHGs, however this analysis applies the 20-year GWP for methane of 86 to all methane emissions in both 2008 and 2014.

Using the results below, the County government has actually seen a 10 percent increase in its GHG emissions since 2008 (Table 3). Applying this conclusion to the Inventory calls for substantial and significant actions to reduce the community's use of natural gas coming from hydro-fracked shale formations.

	2008 New Accounting 5th IPCC 20-yr GWP for Methane with 3.8% Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 5% Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 12% Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 19% Leakage
MTCO ₂ e from Leaked Methane	2,551	2,612	6,768	11,642
Total Government MTCO ₂ e w/o Leakage	6,336	3,012	3,012	3,012
Total Government MTCO ₂ e with Leakage	8,887	5,624	9,780	14,654
Percent Change from 2008 at 3.8% Leakage	n/a	-37%	10%	65%

Table 3. Comparison of Emissions, Shale Gas Leakage 3.8% and 5-19% & 20-Year GWP for Methane 86

Next Steps for Reducing Greenhouse Gas Emissions from County Government Operations

Although Tompkins County has made significant reductions in its government emissions since 2008, plans are underway that will further reduce energy use and emissions.

Energy Roadmap

The Tompkins County Energy Roadmap was identified as a priority of the 2020 Energy Strategy to implement specific initiatives to help the County and its community to achieve the first 20 percent reduction in emissions by 2020. Published in 2016, the Energy Roadmap evaluated local energy resources and developed scenarios to meet the 80 percent greenhouse gas emission reduction goal while meeting energy needs projected through 2050. The energy planning guidance provided in the Energy Roadmap, which is applicable to County government operations as well as the community, includes a short-term goal of achieving efficiency potential averaging 35 percent in existing buildings, and the following intermediate goals:

- Reduce natural gas use by 50 percent and grid electricity generated outside of Tompkins County by 24 percent from current levels.
- Develop 50 percent of solar potential, 20 percent of wind potential and 20 percent of micro-hydro potential and track progress.
- Develop 50 percent of biomass potential, and install significant numbers of ground and air source heat pumps particularly in new construction; buildings that use fuel oil, propane, or electric resistance heat; or when existing heating systems have surpassed their useful life
- Transition 50 percent of light vehicles from gasoline to electric and avoiding any growth in vehicle miles traveled are appropriate intermediate planning goals.

This guidance should inform the next steps the County takes to reduce emissions within its own operations and facilities.

Renewable Energy and Improved Efficiencies

In March 2016, the Tompkins County Legislature authorized execution of a 20-year hydroelectric remote net metering agreement between the County and Gravity Renewables, Inc., which is renovating a hydroelectric plant in Waterloo, NY. The County will pay Gravity Renewables a fee to operate based on a kWh basis and in return will receive a credit on its electric bills for the electricity produced, which is expected to be approximately 63 percent of the County's electricity consumption.¹⁹ The agreement provides the County with predictable electricity costs for this portion of its consumption, and assigns the environmental attributes of this renewable energy to the County to reduce its emissions.

Additionally, the County's recently completed New York Prize Microgrid Study (Stage I) and planned energy improvements to the Airport Terminal indicate that significant potential remains to improve energy efficiency and increase renewable energy generation. This could make up the balance of electricity needed for County government operations that will not be supplied through the agreement with Gravity Renewables. Given the great strides made in reducing emissions associated with electricity consumption, the Terminal improvements will also dramatically reduce natural gas use

Updating County Policies

Tompkins County has a number of policies in place that encourage reduction in County government emissions including:

- Facilities Management and Workplace Environment Policy (Policy 06-09, adopted 1993 and modified 2009): addressing topics such as energy reduction, thermostat settings, and use of appliances in County buildings.
- Waste Reduction and Resource Management Policy (Policy 06-15, 2007): adopts procedures to reduce waste and to increase reuse, recycling, composting, and environmentally preferable purchasing programs; states additional goal of educating employees.
- Green Fleet Policy (Policy 01-44, 2009): calls for measuring performance of County-owned motor vehicles, having departments submit plans for reducing GHG, inventorying vehicles, and establishing a Fleet Management Team.
- Green Building Policy (Policy 01-47, 2013): adopts a minimum of the equivalent of LEED Silver green building standards for all new construction and major renovation of County-owned buildings.

Given the significant emissions and costs associated with the County vehicle fleet, plans are underway to update the Green Fleet Policy in 2016 and the County's first purchase of electric vehicles are also planned this year. This should result in better planning, purchasing, and monitoring of individual department fleets while further reducing emissions associated with the fleet. Once completed, additional policies can be reviewed to determine whether they are being implemented effectively and are adequate to assist the County in meeting its emissions goals.

¹⁹ Tompkins County Resolution 2016-53, adopted March 15, 2016, https://tompkinscountyny.igam2.com/Citizens/Detail_Legifile.aspx?ID=6202&highlightTerms=hydroelectric.

Electric Vehicles

2014, Tompkins County received a grant to develop an electric vehicle infrastructure plan for Tompkins County, which included a review of charging stations and what would be needed to install them and where charging stations should be located. Recently, New York State has been making an effort to reduce the cost of electric vehicles and as part of the process has asked municipalities how many vehicles they might consider purchasing if costs were lower. Tompkins County is currently planning to purchase five electric vehicles for its fleet. As County parking lot projects are planned, the infrastructure needed underneath parking surfaces for charging stations will be installed to prepare for these vehicle purchases and the charging stations that they, and the growing fleet of privately-owned electric vehicles, will require.

EPA Green Power Partnership

In September 2015, Tompkins County joined the U.S. EPA Green Power Partnership Program, which commits an organization to report its green power use annually and, given Tompkins County's electricity use, to procure at least 10 percent of the organization's electricity through green power.

Monitoring Progress

The results of this Inventory will be used to inform the County's future efforts to reduce its GHG emissions and reduce consumption of energy in its government operations. In order to ensure these efforts achieve the desired results, additional monitoring will be needed. For example, future contracts to collect waste and recyclables from County facilities could include reporting of the weight of materials collected to calculate Scope 3 emissions from waste generated at County facilities, and a system for tracking employee commuting emissions could be established to track information that was not available for the purposes of this Inventory. Also, as the County investigates more efficient ways to track energy and vehicle fuel use, there are opportunities to more frequently monitor such data to track progress between larger full inventory efforts such as this one.